



RCE/2814

REQUEST  
FOR  
CONTINUED EXAMINATION (RCE)  
TRANSMITTAL

Subsection (b) of 35 U.S.C. § 132, effective on May 29, 2000,  
provides for continued examination of an utility or plant application  
filed on or after June 8, 1995.  
See The American Inventors Protection Act of 1999 (AIPA).

Application Number	10/004,714
Filing Date	December 5, 2001
First Named Inventor	Scott G. Meikle
Group Art Unit	2814
Examiner Name	Ginette Peralta
Attorney Docket Number	303.444US\$ # 10 RCE

This is a Request for Continued Examination (RCE) under 37 CFR § 1.114 of the above-identified application entitled  
METHOD OF DEPOSITING TUNGSTEN NITRIDE USING A SOURCE GAS COMPRISING SILICON.

M. Braun  
3/2/03

Submission required under 37 C.F.R. § 1.114

1. ☐ Consider the amendment(s)/reply under 37 C.F.R. § 1.116 previously filed on .
2. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on .
3. ☒ A Response ( 12 pages ) is enclosed.
4. ☐ A new power of attorney ( pages ) is enclosed.
5. ☐ An Information Disclosure Statement is enclosed ( pages ).
  - a. Form(s) 1449
  - b. Copies of IDS Citations
6. ☒ A check in the amount of \$750.00 is attached to pay the RCE filing fee required under C.F.R. § 1.17(e).
7. ☒ **The Commissioner is hereby authorized to credit overpayments or charge any fees set forth in 37 CFR §§ 1.16 through 1.18 to Deposit Account No. 19-0743.**
8. ☒ A petition for extension of time in the prior application ( 1 pages ) is enclosed along with a check in the amount of \$110.00.00 to pay the extension fee.
9. ☐ Others:

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**CERTIFICATE UNDER 37 CFR 1.8:** The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Attn-Mail Stop RCE, Commissioner for Patents, P.O.Box 1450, Alexandria, VA 22313-1450, on this 13th day of May, 2003.

Name Amy Moriarty

Signature Amy Moriarty

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EXPEDITED PROCEDURE – EXAMINING GROUP 2814

S/N 10/004714

PATENT



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Scott G. Meikle et al.

Examiner: Ginette Peralta

Serial No.: 10/004,714

Group Art Unit: 2814

Filed: December 5, 2001

Docket No.: 303.444US5

Title: METHOD OF DEPOSITING TUNGSTEN NITRIDE USING A SOURCE GAS  
COMPRISING SILICON

RESPONSE

Mail Stop RCE  
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Response  
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J. Braun  
4/21/03  
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Applicant has carefully reviewed and considered the Office Action mailed on January 15, 2003 and the Advisory Action mailed April 9, 2003.

This response is accompanied by a Petition, as well as the appropriate fee, to obtain a one-month extension of the period for responding to the Office action, thereby moving the deadline for response from April 15, 2003 to May 15, 2003.

No claims are amended. No claims are canceled. No claims are added. Claims 38-74 remain pending in this application.

**§112 Rejection of the Claims**

In the Office Action mailed on January 15, 2003, claims 41-74 were rejected under 35 USC § 112, first paragraph. The rejections states:

*... the specification, while being enabling for a tungsten nitride layer, does not reasonably provide enablement for a tungsten nitride layer that includes silicon. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make the invention commensurate in scope with these claims.*

Applicant respectfully traverses, and respectfully asserts that the specification does enable a tungsten nitride layer that includes silicon. The tungsten nitride is chemically vapor

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deposited from a source gas comprising a silicon based gas (page 3 lines 9-10, page 5 lines 4-5). The specification identifies tungsten sources, nitrogen sources, and silicon sources for the source gas (page 6 lines 3-9). Additionally, the specification identifies pressures, temperatures and flow rates (page 6 line 9 to page 7 line 8). Applicant respectfully asserts that the disclosure in the present application enables one of ordinary skill in the art to make a tungsten nitride layer that includes silicon.

The rejection further states:

*Applicant's specification is directed to a capacitor comprising a tungsten nitride electrode or electrodes, there is no enablement for a tungsten nitride layer including silicon, if the tungsten nitride layer were to include silicon then it would be a tungsten silicon nitride electrode, and not a tungsten nitride layer . . .*

Applicant respectfully traverses. The specification clearly indicates that the source gas includes silicon. For example, the specification indicates that the source gas comprises a silicon based gas (page 6 lines 7-9), and that silane or other silicon based gas is added to the source gas mixture at a flow rate that falls within a specific range of the total flow rate of the source gas (page 6 line 20 to page 7 line 8). Furthermore, the source gas is maintained at a pressure conducive to chemical vapor deposition (page 6 lines 9-10). Additionally, the specification indicates that the addition of silane or other silicon-based gas reduces encroachment into any silicon based materials exposed to the tungsten nitride, improves adhesion of the tungsten nitride to its underlying layer, and reduces the bulk resistivity of the tungsten nitride (page 7 lines 1-5). Thus, the addition of the silicon-based gas directly affects the deposited layer. Applicant respectfully asserts that, based on the processing conditions and the results recited in the specification, one of one of ordinary skill in the art would understand that the resulting deposited material includes silicon.

Applicant respectfully points out that the flow rate for the silicon based gas is relatively small with respect to the total flow rate of the source gas. Thus, the amount of silicon deposited is relatively small with respect to the tungsten nitride. Applicant respectfully disagrees with the statement made in the rejection that, *if the tungsten nitride layer were to include silicon then it would be a tungsten silicon nitride electrode*. This statement improperly presupposes that the

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only way to refer to a layer that includes tungsten, nitrogen and silicon is to refer to it as tungsten silicon nitride, and that the silicon must form chemical bonds with the tungsten and nitride. Such chemical bonds are not automatically formed under the processing conditions provided in the specification. For example, Applicant notes that carbon steel includes carbon that is not chemically bonded.

Applicant respectfully asserts that a tungsten nitride layer including silicon is clearly supported in the specification to one of ordinary skill in the art.

The rejection further states:

*furthermore, applicant's specification mentions the use of silane on the deposition of the tungsten nitride layer but no basis is provided for the silicon to be included in the deposited tungsten nitride layer. Furthermore, this would be a process limitation and the claims are directed to a device.*

Applicant respectfully traverses. Upon reading and comprehending the disclosure, one of ordinary skill in the art will understand that a tungsten nitride material formed by CVD using a source gas that includes silicon will include silicon.

The claims are directed to a device (an end product), which is novel and nonobvious over known devices. Forming the chemically vapor deposited tungsten nitride in which the tungsten nitride is formed using a gas comprising nitrogen, tungsten and silicon provides a patentable end product. The silicon reduces encroachment into any silicon based materials exposed to the tungsten nitride, improves adhesion of the tungsten nitride to its underlying layer, and reduces the bulk resistivity of the tungsten nitride (page 7, lines 1-4).

The Advisory Action includes additional comment regarding the 35 USC § 112, first paragraph rejection. These comments are addressed below in the section entitled Response to Advisory Action.

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*§102 and §103 Rejections of the Claims*

Applicant notes that the Office Action mailed on January 15, 2003 repeats the §102 and §103 rejections that were made in a previous Office Action. Applicant's traversal of those rejections are still applicable.

*§102 Rejection of the Claims*

In the Office Action mailed on January 15, 2003, claims 41, 43-48, 51, 58, and 60 were rejected under 35 USC § 102(b) as being anticipated by Mishmash (JP 406275776 A). Applicant respectfully traverses.

With respect to amended independent claim 41, Applicant is unable to find, among other things, in the Matsushashi reference a capacitor having a tungsten nitride layer that includes silicon, as recited in the claim. Claims 42-45 depend on amended independent claim 41, and further define the present subject matter. Thus, claims 42-45 are believed to be patentable at least for the reasons provided with respect to claim 41.

With respect to amended independent claim 46, Applicant is unable to find, among other things, in the Matsushashi reference a capacitor comprising a second electrode formed as a layer of tungsten nitride that includes silicon, as recited in the claim. Claims 47-51 depend on amended independent claim 46, and further define the present subject matter. Thus, claims 47-51 are believed to be patentable at least for the reasons provided with respect to claim 41.

With respect to amended independent claim 58, Applicant is unable to find, among other things, in the Matsushashi reference a capacitor comprising a film of tungsten nitride that includes silicon, as recited in the claim. Claims 59-61 depend on amended independent claim 58, and further define the present subject matter. Thus, claims 59-61 are believed to be patentable at least for the reasons provided with respect to claim 58.

Applicant respectfully requests withdrawal of the rejection, and reconsideration and allowance of claims 41, 43-48, 51, 58 and 60.

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Dkt: 303.444US5*§103 Rejection of the Claims*

In the Office Action mailed on January 15, 2003, claims 38-40, 42, 49, 50, 52-57, 59, and 61 were rejected under 35 USC § 103(a) as being unpatentable over Matsushashi. Applicant respectfully traverses.

Applicant respectfully traverses the single reference rejection under § 103. Should the Examiner maintain the rejection, Applicant requests the Examiner to cite references in support of the rejection pursuant to M.P.E.P. 2144.03.

With respect to independent claim 38, Applicant is unable to find, among other things, in the Matsushashi reference a showing or suggestion of a capacitor comprising a second electrode formed of chemically vapor deposited tungsten nitride in which the tungsten nitride is formed using a gas comprising nitride, tungsten and silicon, as recited in the claim. This process results in a tungsten nitride layer that includes silicon. The silicon reduces encroachment into any silicon based materials exposed to the tungsten nitride, improves adhesion of the tungsten nitride to its underlying layer, and reduces the bulk resistivity of the tungsten nitride (page 7, lines 1-4). Claims 39-40 depend on independent claim 38, and further define the present subject matter. Thus, claims 39 - 40 are believed to be patentable at least for the reasons provided with respect to claim 38.

Applicant notes that claim 42 depends on claim 41 and further defines the present subject matter. Thus, claim 42 is believed to be patentable at least for the reasons provided with respect to claim 41. Additionally, Applicant respectfully disagrees with the characterization that forming both electrodes to include tungsten nitride involves a rearrangement of parts.

Applicant notes that claims 49-50 depend on claim 46 and further define the present subject matter. Thus, claims 49-50 are believed to be patentable at least for the reasons provided with respect to claim 46. Additionally, with respect to claim 50, Applicant is unable to find, among other things, in the Matsushashi reference a showing or suggestion that the layer of tungsten nitride is exposed to silicon based materials, and a tungsten nitride / silicon based material boundary is characterized by a reduced encroachment of the tungsten nitride into the silicon based materials, as recited in the claim.

With respect to amended independent claim 52, Applicant is unable to find, among other things, in the Matsushashi reference a showing or suggestion of a capacitor comprising a first

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electrode formed as a layer of tungsten nitride in which the layer tungsten nitride includes silicon, as recited in the claim. Claims 53-57 depend on independent claim 52, and further define the present subject matter. Thus, claims 53-57 are believed to be patentable at least for the reasons provided with respect to claim 52.

Applicant notes that claims 59 and 61 depend on claim 58 and further define the present subject matter. Thus, claims 59 and 61 are believed to be patentable at least for the reasons provided with respect to claim 58.

Applicant respectfully requests withdrawal of the rejection, and reconsideration and allowance of claims 38-40, 42, 49, 50, 52-57, 59 and 61.

Claims 62-74 were rejected under 35 USC § 103(a) as being unpatentable over Matsushashi in view of Wolf, *Silicon Processing for the VLSI Era, Vol. 2: Process Integration*. Applicant respectfully traverses.

With respect to amended independent claim 62, Applicant is unable to find, among other things, in the Matsushashi and Wolf references a showing or suggestion of a capacitor comprising a film of tungsten nitride that includes silicon, as recited in the claim. Claims 63-65 depend on independent claim 62, and further define the present subject matter. Thus, claims 63-65 are believed to be patentable at least for the reasons provided with respect to claim 62.

With respect to amended independent claim 66, Applicant is unable to find, among other things, in the Matsushashi and Wolf references a showing or suggestion of a capacitor comprising a film of tungsten nitride formed using: ammonia; tungsten hexafluoride or tungsten carbonyl; and silane, organic silane or a compound that is a multiple order of silane, as recited in the claim. This process results in a tungsten nitride layer that includes silicon. The silicon reduces encroachment into any silicon based materials exposed to the tungsten nitride, improves adhesion of the tungsten nitride to its underlying layer, and reduces the bulk resistivity of the tungsten nitride (page 7, lines 1-4). Claims 67-68 depend on independent claim 66, and further define the present subject matter. Thus, claims 67-68 are believed to be patentable at least for the reasons provided with respect to claim 66.

With respect to amended independent claim 69, Applicant is unable to find, among other things, in the Matsushashi and Wolf references a showing or suggestion of a non-planar capacitor

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where an electrode includes a tungsten nitride layer, and the tungsten nitride layer includes silicon, as recited in the claim. Claims 70-74 depend on independent claim 66, and further define the present subject matter. Thus, claims 70-74 are believed to be patentable at least for the reasons provided with respect to claim 69.

Applicant respectfully requests withdrawal of the rejection, and reconsideration and allowance of claims 62-74.

**Response to Arguments in Office Action Mailed on January 15, 2003**

In the Office Action mailed on January 15, 2003, the rejection stated that *the method of forming a device is not germane to the issue of patentability of the device itself*. Applicant respectfully disagrees. Product by process claims are proper (MPEP 2173.05(p) citing *In re Luck*, 476, F.2d 650, 177 USPQ 523 (CCPA 1973)). A patentable end product is provided by forming the electrode using chemically vapor deposited tungsten nitride in which the tungsten nitride is formed using a gas comprising nitride, tungsten and silicon. The silicon reduces encroachment into any silicon based materials exposed to the tungsten nitride, improves adhesion of the tungsten nitride to its underlying layer, and reduces the bulk resistivity of the tungsten nitride (page 7, lines 1-4). The references relied upon do not show or suggest this end product.

In the Office Action mailed on January 15, 2003, the rejection stated that *there is no single statement in the specification that reads that the layer formed is a "tungsten nitride layer including silicon."* Applicant respectfully asserts that the specification indicates that the source gas used in the CVD process includes a tungsten-containing gas, a nitride-containing gas, and a silicon-containing gas. One of ordinary skill in the art would understand, upon reading and comprehending the disclosure, that the resulting tungsten-nitride includes silicon.

In the Office Action mailed on January 15, 2003, the rejection stated that *if the layer where to include silicon then it would become a tungsten silicon nitride layer (WSiN) which is not mentioned in the specification as being the formed layer*. This statement improperly presupposes a specific chemical bonding between the elements. Applicant respectfully asserts that a tungsten nitride layer including silicon definitely recites an element of the claimed subject matter.



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**Response to Arguments in Advisory Action Mailed on April 9, 2003**

The comments provided in the Advisory Action relate to the rejection under 35 USC § 112, first paragraph, which requires that the specification include: (a) a written description of the invention; (b) the manner and process of making and using the invention (the enablement requirement); and (c) the best mode contemplated by the inventor of carrying out his invention. MPEP 2161. Applicant notes that, although not explicitly laid out, the arguments provided in the rejection are generally directed toward the enablement requirement, and appear to touch on the written description requirement. As such, Applicant will address the written description and enablement requirements of 35 USC § 112..

**Written Description Standard**

An objective standard for determining compliance with the written description requirement, as provided in MPEP 2163.02, is "does the description clearly allow persons of ordinary skill in the art to recognize that he or she invented what is claimed." *In re Gosteli*, 872 F.2d 1008, 1012, 10 USPQ2d 1614, 1618 (Fed. Cir. 1989). The subject matter of the claim need not be described literally (i.e., using the same terms or *in haec verba*) in order for the disclosure to satisfy the description requirement. MPEP 2163.02. Rather, an adequate written description of the invention may be shown by any description of sufficient, relevant, identifying characteristics so long as a person skilled in the art would recognize that the inventor had possession of the claimed invention. MPEP 2163 (citing *Purdue Pharma L.P. v. Faulding Inc.*, 230 F.3d 1320, 1323, 56 USPQ2d 1481, 1483 (Fed. Cir. 2000)).

**Enablement Standard**

The standard for determining whether the specification meets the enablement requirement is: *Is the experimentation needed to practice the invention undue or unreasonable?* (MPEP 2164.01, citing *Mineral Separation v. Hyde*, 242 U.S. 261, 270 (1916)). The test of enablement is whether one reasonably skilled in the art could make or use the invention from the disclosures in the patent coupled with information known in the art without undue experimentation. *United States v. Telectronics, Inc.*, 857 F.2d 778, 785, 8 USPQ2d 1217, 1223 (Fed. Cir. 1988). MPEP

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2164.01(a) states that there are many factors to be considered when determining whether there is sufficient evidence to support a determination that a disclosure does not satisfy the enablement requirement and whether any necessary experimentation is "undue." These factors include, but are not limited to: (A) the breadth of the claims; (B) the nature of the invention; (C) the state of the prior art; (D) the level of one of ordinary skill; (E) the level of predictability in the art; (F) the amount of direction provided by the inventor; (G) the existence of working examples; and (H) the quantity of experimentation needed to make or use the invention based on the content of the disclosure. The determination that "undue experimentation" would have been needed to make and use the claimed invention is not a single, simple factual determination. Rather, it is a conclusion reached by weighing all the above noted factual considerations. 2164.01(a) citing *In re Wands*, 858 F.2d at 737, 8 USPQ2d at 1404. The more that is known in the prior art about the nature of the invention, how to make, and how to use the invention, and the more predictable the art is, the less information needs to be explicitly stated in the specification. MPEP 2164.03. The determination should always be based on the weight of all the evidence, and never should be based on personal opinion. MPEP 2164.05.

Applicant respectfully submits that the CVD process is well-known to those of ordinary skill in the semiconductor art. Given the source gases identified in the specification and the direction provided in the specification (including the specific fabrication example), one of ordinary skill in the art would find, upon reviewing and comprehending the disclosure, that the result of a CVD process is predictably tungsten nitride that includes silicon. The application clearly discloses a source gas mixture having a silicon based gas (e.g. Abstract) for a CVD process. Furthermore, the application makes a distinction between source gases and carrier gases (page 4, lines 8-14). Additionally, the Background of the application states that byproducts of the deposition reactions ( $WF_6$  and  $NH_3$ ) can cause encroachment into silicon or polycrystalline silicon substrates (page 2, lines 12-15). The use of a source gas including silicon to form tungsten nitride results in a patentable structure reduces encroachment into any silicon based materials exposed to the tungsten nitride, improves adhesion of the tungsten nitride to its underlying layer, and reduces the bulk resistivity of the tungsten nitride (page 5, lines 1-4).

The Advisory Action mailed on April 9, 2003 stated: *Regarding Applicant's argument that the tungsten nitride layer includes silicon as it is chemically vapor deposited from a source*

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*gas comprising silicon based gas, it is noted that the silicon-including gas does not necessarily decompose in order to integrate silicon to the tungsten nitride layer.* Applicant respectfully asserts that the necessity of decomposition is not a determinative factor for enablement (whether one of ordinary skilled in the art could make or use the invention from the disclosures in the patent coupled with information known in the art without undue experimentation). Even so, Applicant asserts that one of ordinary skill in the art would understand, upon reading and comprehending the application, that a CVD process using the disclosed source gas would result in a tungsten nitride layer that includes silicon under most processing conditions, including the conditions cited in the specification. Furthermore, Applicant asserts that the written description requirement has been met, since an adequate written description of the invention may be shown by any description of sufficient, relevant, identifying characteristics so long as a person skilled in the art would recognize that the inventor had possession of the claimed invention MPEP 2163 (citing *Purdue Pharma L.P. v. Faulding Inc.*, 230 F.3d 1320, 1323, 56 USPQ2d 1481, 1483 (Fed. Cir. 2000)).

Additionally, the Advisory Action mailed on April 9, 2003 stated: *furthermore it is noted that nowhere in the specification it is disclosed that the tungsten nitride layer includes silicon.* With respect to the enablement requirement, Applicant respectfully asserts that the determination that "undue experimentation" would have been needed to make and use the claimed invention is not a single, simple factual determination, but is rather, a conclusion reached by weighing factual considerations. MPEP 2164.01(a), and further asserts that one of ordinary skill in the art is enabled by the specification whether or not the specification explicitly states that the tungsten nitride includes silicon. With respect to the written description requirement, the subject matter of the claim need not be described literally (i.e., using the same terms or *in haec verba*) in order for the disclosure to satisfy the description requirement. MPEP 2163.02.

The Advisory Action mailed on April 9, 2003 stated: *the silicon including gas could be used as a carrier gas, and that when used as a carrier gas no silicon is included in the deposited layer as a direct result including the silicon including gas in the mixture.* Applicant respectfully asserts that, even if true, this argument does not support a position consistent with the rejection under the enablement requirement that one of ordinary skilled in the art could not make or use the claimed invention without undue experimentation. Applicant respectfully points out that an

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examiner's determination of enablement based on personal opinion is not proper. MPEP 2164.05. Applicant respectfully asserts that one of ordinary skill in the art could make or use the invention from the disclosures in the patent coupled with information known in the art without undue experimentation. Thus, Applicant asserts that the claims are enabled. Applicant further asserts that this argument does not support a position consistent with the rejection, under the written description requirement, that a person skilled in the art would not recognize that the inventor had possession of the claimed invention. The application clearly indicates that the source gas include silicon (Abstract).

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Conclusion

Applicant respectfully requests reconsideration and allowance of the claims. Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested.

The Examiner is requested to telephone Applicant's attorney (612) 373-6960 to facilitate prosecution of this application. If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

SCOTT G. MEIKLE ET AL.

By their Representatives,

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Date 5-13-03

By M L B

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Amy Moriarty

Name

Amy Moriarty

Signature